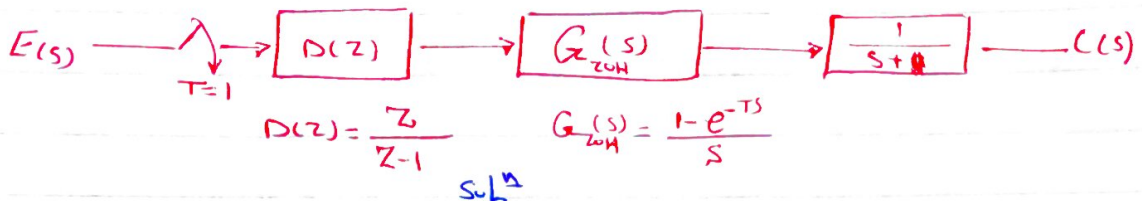


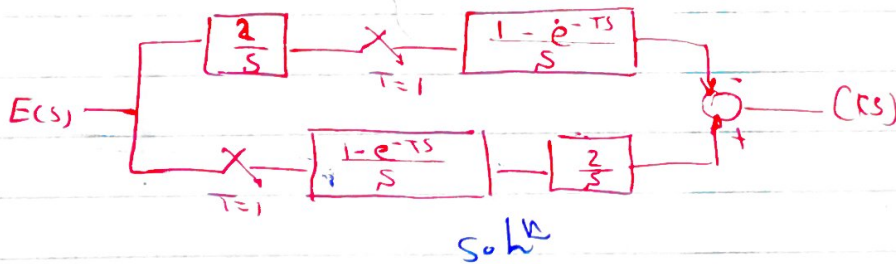
## Sheet 2

2 Find Pulse Transfer function of



$$\begin{aligned} \frac{C(z)}{D(z)} &= D(z) \mathcal{Z} \left[ \frac{1-e^{-Ts}}{s(s+1)} \right] = \frac{z}{z-1} \cdot (1-z^{-1}) \mathcal{Z} \left[ \frac{1}{s(s+1)} \right] \\ &= \mathcal{Z} \left[ \frac{1}{s} - \frac{1}{s+1} \right] = \mathcal{Z} [u(k) - e^{-k}] \\ &= \frac{z}{z-1} - \frac{z}{z-e^{-1}} = \frac{z(z-0.368) - z(z-1)}{(z-1)(z-0.368)} = \boxed{\frac{0.632z}{(z-1)(z-0.368)}} \end{aligned}$$

4 Find the output  $C(k)$  for  $e(t)$  equal to unit step



$$\begin{aligned} C(z) &= E(z) \mathcal{Z} \left[ \frac{2(1-e^{-Ts})}{s^2} \right] - \mathcal{Z} \left[ \frac{1-e^{-Ts}}{s} \right] \mathcal{Z} \left[ \frac{2}{s} \cdot E(s) \right] \\ &= \frac{z}{z-1} \cdot (1-z^{-1}) \mathcal{Z} \left[ \frac{2}{s^2} \right] - (1-z^{-1}) \mathcal{Z} \left[ \frac{1}{s} \right] \mathcal{Z} \left[ \frac{2}{s^2} \right] \\ &= \frac{2z}{(z-1)^2} - \frac{2z}{(z-1)^2} = \text{zero} \end{aligned}$$

unit step  
 $E(s) = \frac{1}{s}$

Find  $C(z)$

Sol<sup>n</sup>

$$C(s) = G(s) E(s) \quad \dots (1)$$

$$E(s) = R^*(s) - H(s) C^*(s) \quad \dots (2)$$

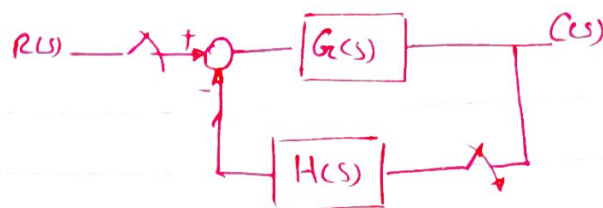
$$\therefore C(s) = G(s) [R^*(s) - H(s) C^*(s)] \quad // \text{ substitute by 2 in 1}$$

$$C(s) = G(s) R^*(s) - G(s) H(s) C^*(s) \quad \# \dots (3)$$

$$\text{starting} \rightarrow C^*(s) = G^*(s) R^*(s) - G(s) H(s) C^*(s) \quad // \text{ starting of 3}$$

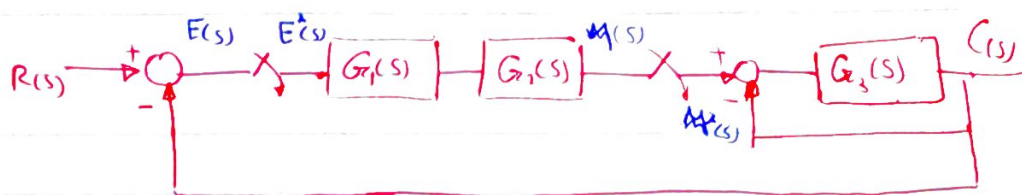
$$C^*(s) (1 + G(s) H(s)) = G^*(s) R^*(s)$$

$$\frac{C^*(s)}{R^*(s)} = \frac{G^*(s)}{1 + G(s) H(s)} \rightarrow \frac{C(z)}{R(z)} = \frac{G(z)}{1 + G(z) H(z)}$$



Find  $\frac{C(z)}{R(z)}$

Sol<sup>n</sup>



$$C(s) = G_3(s) [M^*(s) - C(s)]$$

$$(1 + G_3(s)) C(s) = G_3(s) M^*(s)$$

$$\therefore C(s) = \frac{G_3(s)}{1 + G_3(s)} M^*(s)$$

But we have

$$M(s) = G_1 G_2(s) E^*(s) = G_1 G_2(s) (R(s) - C(s))^*$$

$$= G_1 G_2(s) (R^*(s) - C^*(s))$$

Starting of M

$$M^*(s) = \overline{G_1 G_2}^*(s) (R^*(s) - C^*(s))$$

$$\therefore C(s) = \frac{G_3(s)}{1 + G_3(s)} \overline{G_1 G_2}^*(s) (R^*(s) - C^*(s))$$

Starting above eqn

$$C^*(s) = \left[ \frac{G_3(s)}{1 + G_3(s)} \right]^* \overline{G_1 G_2}^*(s) (R^*(s) - C^*(s))$$

$$\frac{C^*(s)}{R^*(s)} = \frac{\left[ \frac{G_3(s)}{1 + G_3(s)} \right]^* \overline{G_1 G_2}^*(s)}{1 + \left[ \frac{G_3(s)}{1 + G_3(s)} \right]^* \overline{G_1 G_2}^*(s)}$$

Note

we first  
substitute then  
start the eqn